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On Green Growth with Sustainable Capital

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In the UK, the flagship of growth Industrial Strategy is to boost green growth through the promotion of cost-effective low carbon technologies. While the industrial strategy lays out the goals of clean growth, it is less clear about the trade-offs facing the economy in meeting this target.

The challenge emanates from a long standing theoretical and policy debate in resource and environment economics on whether growth is possible without exhausting natural resources. Since natural resources (natural or green capital) are part of the capital stock, we define sustainable growth in terms of the aggregate capital stock. Broadly, aggregate capital is the sum total of natural and man-made capital. According to Heal (2017), an economy is sustainable if the value of aggregate capital stock is nondecreasing.

The proponents of strong sustainability (Daly, 1997; Ayres, 2007) take the stand that the stock of natural capital must be non-decreasing which disallows substitution between natural and man-made capital. Solow (1974) and Nordhaus and Tobin (1972) take a weak sustainability view that some degree of substitution is possible between these two types of capital. The crux of the debate boils down to whether natural and man-made capital are substitutable and a socially acceptable sustainable low carbon growth is achievable. If so, what policy instruments could accomplish this task?

We develop an endogenous growth model to address a long standing question whether sustainable green growth is feasible by re-allocating resource use between green (natural) and man-made (carbon intensive) capital. Although the model is general we relate it to the UK's green growth policy objective. In our model, final output is produced with two reproducible inputs, green and man-made capital. The growth of man-made capital causes depreciation of green capital via carbon emissions and related externalities which the private sector does not internalize.

The punch-line of our analysis is that when the source of emissions is production, there is a trade-o¤ between environmental policy and growth. This trade-off arises due to the fact that a carbon tax distorts the resource allocation. This adverse effect on growth is fundamentally due to the absence of a pollution abatement technology.

We then present a scenario where an emissions abatement technology is in place. In this scenario, a combination of carbon tax, public investments in abatement and green capital replenishment could overcome the trade-off between environmental quality and long-run growth. Greater efficiency in pollution abatement boosts the long run growth and lowers the depreciation of green capital and lowers the carbon tax. A pollution abatement technology also presents a pathway to resilience to a climate shock. Our results are consistent with the current environmental policy of net-zero carbon emissions which aims to lower emissions while recognizing that zero emissions is not possible.

We, finally, explore a scenario where the source of pollution is consumption. The optimal carbon tax is zero in this environment because consumption based emission has no direct adverse effect on the green capital base. Thus, there is no trade-off between environment policy and growth. A corrective consumption tax is then needed to finance a public investment programme for replenishing the green capital destroyed by consumption based emissions.

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